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**ANNULAR RING ELEMENT**

**CROSS-REFERENCES TO RELATED APPLICATIONS**

10 [0001] This application claims the priority of Austrian Patent Application A 280/2004 filed  
February 20, 2004, and is a U.S. National Phase application of PCT/AT2005/000048 filed  
February 14, 2005, both of which disclosures are incorporated herein by reference.

~~STATEMENT AS TO RIGHTS TO INVENTIONS MADE UNDER~~

15 ~~FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT~~

~~[0002]—NOT APPLICABLE~~

~~REFERENCE TO A "SEQUENCE LISTING," A TABLE, OR A COMPUTER~~

~~PROGRAM LISTING APPENDIX SUBMITTED ON A COMPACT DISK.~~

20 ~~[0003]—NOT APPLICABLE~~

~~BACKGROUND OF THE INVENTION~~

~~[0004]—~~

**BRIEF SUMMARY OF THE INVENTION**

25 ~~[0002]~~[0005]—The invention relates to a device according to the preamble of annular  
elements ~~claim 1.~~

[0003] ~~[0006]~~—It is known to build conduits or pipe-cased shafts, channel shafts, manholes,  
maintenance shafts or pipelines from individual sections, modules, liners or annular elements,  
30 whereby the annular elements are transported to the building site and are assembled on site.

**[0004] {0007}**—Usually, shafts or lines of this type are lowered, laid or moved in the ground and for the most part poured in concrete or placed as industrially produced prefabricated parts, i.e. in the form of pipe-cased shafts cast in concrete. To give the construction as secure and permanent a support as possible in the preset position, longitudinal and/or transverse ribs  
5 are configured on the outer side of the elements.

**[0005] {0008}**—In conventional forms of the annular elements, the longitudinal ribs extend parallel to the generatrix and/or parallel to the central median axis of the cylindrical or truncated conical annular element. The direction of projection direction, i.e. the direction in which the longitudinal ribs point, is essentially radial, i.e. pointing radially outward from the median axis of the annular element.  
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**[0006] {0009}**—By this type of radial construction of the longitudinal ribs, the production of the elements, optionally by injection-molding processes, is expensive and difficult since it results in undercuts when removing the finished component from the die. Consequently, expensive mold constructions are required during compression molding or injection molding  
15 of the elements.

**[0007] {0010}**—[[The]] An object of the invention is to avoid the aforementioned disadvantages.

**[0008] {0011}**—Furthermore, it is [[the]] an object of the invention to provide elements of the above-noted type for pipe-cased shafts, channel shafts, manholes, maintenance shafts or  
20 pipes, optionally to be poured in concrete or cast, which are as stable and waste-water resistant as possible and that are permanently secured in their position, in particular against distortions or destructions or separations caused by ground movements and which or whose individual parts can be easily and simply produced or removed from the mold and that can be simultaneously stored, stacked or transported in a space-saving manner.

**[0009] {0012}**—According to the invention, this is attained by the characterizing features of embodiments of the invention ~~claim 1~~. This does not result in any undercuts of the longitudinal ribs when removing from the mold, instead the mold can be pulled off from the annular element along the direction of forming without damaging the longitudinal ribs or it being necessary to fold or bend the form or the annular element. At the same time, there are  
25 defined resistance forces or directions of force for the anchoring.  
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## BRIEF SUMMARY OF THE INVENTION

**[0010]** ~~**[0013]**~~—Structurally and with respect to strength, it is especially advantageous if the features of embodiments of the invention ~~claim 2~~ are developed.

5 **[0011]** ~~**[0014]**~~—For structural reasons and to make the annular element more stable, it is advantageous if the features of embodiments of the invention ~~claim 3~~ are developed.

**[0012]** ~~**[0015]**~~—To ensure a better anchoring in the ground or in the surrounding ground or concrete, the features of embodiments of the invention ~~claim 4~~ are advantageously developed.

10 **[0013]** ~~**[0016]**~~—To give the construction additional stability and rigidity and to be able to better anchor the elements in the surrounding ground or concrete, it is advantageous if the features of embodiments of the invention ~~claim 5~~ are developed.

**[0014]** ~~**[0017]**~~—The features of embodiments of the invention ~~claim 6~~ give the advantage that the production is simpler since the size of the mold and the machines can be reduced and that the segments of the pipe-cased shaft can be more easily transported with greater space-  
15 savings.

**[0015]** ~~**[0018]**~~—The features of embodiments of the invention ~~claim 7~~ ensure that many similar parts can be produced in a single production form.

**[0016]** ~~**[0019]**~~—For production reasons, it is advantageous if the features of embodiments of the invention ~~claim 8~~ are developed. This substantially facilitates the removal of the mold  
20 from the production machine or the injection-molding machine since it can be pulled off without undercutting the ribs or bending or cracking the annular element or mold.

**[0017]** ~~**[0020]**~~—In this connection, it is especially advantageous if the features of embodiments of the invention ~~claim 9~~ are developed.

**[0018]** ~~**[0021]**~~—For production reasons and to ensure an optimal anchoring of the annular  
25 element in the ground or in the concrete, it is advantageous if the features of embodiments of the invention ~~claim 10~~ are developed.

**[0019]** ~~**[0022]**~~—To be able to distribute the forces as uniformly as possible and to anchor the annular element as uniformly as possible in the ground or in the concrete and to secure it

against twisting, it is advantageous if the features of embodiments of the invention ~~claims 11, 12 and 13~~ are developed.

**[0020] {0023}**—The features of embodiments of the invention ~~claim 14~~ ensure that the annular segments can be easily and accurately connected to form a complete annular element.

5 **[0021] {0024}**—To be able to easily, quickly and accurately assemble several annular elements, it is advantageous if the features of embodiments of the invention ~~claim 15~~ are developed.

**[0022] {0025}**—For the secure connection or to connect the individual segments or elements together as exactly and permanently as possible, it is advantageous if the features of the  
10 embodiments of the invention ~~claim 16~~ are developed.

**[0023] {0026}**—The features of embodiments of the invention ~~claim 17~~ ensure an even better rigidity or structural advantages and an improved anchoring in the ground or in the concrete.

**[0024] {0027}**—Additional safeguarding against distortions or displacements are ensured by the features according to c embodiments of the invention ~~claim 18~~.

15 **[0025] {0028}**—For a simple production and a space-saving transport, it is advantageous if the features according to embodiments of the invention ~~claim 19~~ are developed.

**[0026] {0029}**—The pressure stability against the pressure of the surrounding ground and rigidity of the construction is increased by the features of embodiments of the invention ~~claim 20~~.

20 **[0027] {0030}**—Further advantages and embodiments of the invention are found in the description and the attached drawings.

**[0028] {0031}**—The invention is schematically shown in the drawings with reference to embodiments ~~embodiments~~ and described in the following with reference to the drawings by way of example.

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#### BRIEF DESCRIPTION OF THE DRAWINGS

**[0029] {0032}**—Fig. 1a shows an annular element of the invention in a top view.

**[0030] {0033}**—Fig. 1b shows an annular element of the invention in a side view.

- ~~[0031]~~ ~~[0034]~~ Fig. 1c shows an annular element of the invention in ~~cross-section~~ cross-section.
- ~~[0032]~~ ~~[0035]~~ Figs. 1d and 2a show an annular segment as part of an annular element.
- ~~[0033]~~ ~~[0036]~~ Fig. 2b shows a sectional view of the detail A.
- 5     ~~[0034]~~ ~~[0037]~~ Fig. 2c shows a sectional view of the detail B.
- ~~[0035]~~ ~~[0038]~~ Fig. 2d shows a sectional view of detail A in combination with another annular segment.
- ~~[0036]~~ ~~[0039]~~ Fig. 2e shows a ~~cross-section~~ cross-section through the annular segment.
- ~~[0037]~~ ~~[0040]~~ Fig. 2f shows a side view of the annular segment.
- 10    ~~[0038]~~ ~~[0041]~~ Figs. 2g to 2j show sectional views of the details C, D, E, F and G.
- ~~[0039]~~ ~~[0042]~~ Fig. 3a shows a schematic top view onto an annular element with six annular segments.
- ~~[0040]~~ ~~[0043]~~ Fig. 3b shows a schematic top view onto an annular element with three annular segments.
- 15    ~~[0041]~~ ~~[0044]~~ Fig. 3c shows a schematic top view onto an annular element with eight annular segments.
- ~~[0042]~~ ~~[0045]~~ Fig. 3d shows a schematic top view onto an annular element with four annular segments.
- ~~[0043]~~ ~~[0046]~~ Fig. 4a shows a top view onto an annular element in the form of a straight
- 20    truncated cone.
- ~~[0044]~~ ~~[0047]~~ Fig. 4b shows a side view of an annular element in the form of a straight truncated cone.
- ~~[0045]~~ ~~[0048]~~ Fig. 5a shows a top view onto an annular element in the form of a sloping truncated cone.
- 25    ~~[0046]~~ ~~[0049]~~ Fig. 5b shows a side view of the annular element in the form of a sloping truncated cone.

~~[0047]~~ ~~[0050]~~ Fig. 6a shows a top view onto a semi-annular segment in the form of half a truncated cone with transverse ribs.

~~[0048]~~ ~~[0051]~~ Fig. 6b shows the ~~cross-section~~ cross-section of this annular segment.

~~[0049]~~ ~~[0052]~~ Fig. 7 shows an overall view of a channel shaft with concrete-poured annular elements.

~~[0050]~~ ~~[0053]~~ Fig. 8 shows the pattern for determining the direction of projection.

~~[0051]~~ ~~[0054]~~ Figs. 9 and 10 show design details of annular elements.

#### DETAILED DESCRIPTION OF THE INVENTION

~~[0052]~~ ~~[0055]~~ Fig. 1a shows a top view onto a cylindrical annular element. Longitudinal ribs 3 are formed on the outer surface 5 of the annular element 1. As can be seen in Fig. 1b, the longitudinal ribs 3 extend parallel to the generatrix and parallel to the central median axis 7 of the annular element 1.

~~[0053]~~ ~~[0056]~~ Preferably, the longitudinal ribs 3 have an essentially rectangular, or at least partially rectangular, ~~cross-section~~ cross-section, whereby the surface of the longitudinal ribs 3 facing the annular element is adapted to the curvature of the outer surface 5.

~~[0054]~~ ~~[0057]~~ When the longitudinal ribs 3 are shaped rectangular in the ~~cross-section~~ cross-section, at least partial areas of the lateral surfaces of at least two adjacent longitudinal ribs 3 are aligned essentially parallel to one another or project from the outer surface 5 parallel to one another.

~~[0055]~~ ~~[0058]~~ The longitudinal ribs 3 may also have triangular or trapezoidal ~~cross-section~~ cross-section, optionally with rounded points.

~~[0056]~~ ~~[0059]~~ The longitudinal ribs 3 may be made either as solid ribs or as hollow or profiled projections from the outer surface 5, dependent on the production method.

~~[0057]~~ ~~[0060]~~ The important point is that at least two adjacent longitudinal ribs 3 have an essentially parallel direction of projection from the outer surface 5. The projection direction is given by the basic direction in which the longitudinal ribs 3 extend, measured from the inner side of the annular element in the direction of the outer side of the annular element. The projection direction also corresponds to the direction in which the annular segments or annular elements are removed from the mold. The projection direction of longitudinal ribs 3

that are rectangular in ~~eross-section~~ cross-section is essentially determined by the shape of the lateral surfaces.

**[0058] {0061}**—If the projection direction cannot be clearly identified and established without a doubt, the following system can be applied: the ~~eross-section~~ cross-section of a longitudinal rib 3 is thereby defined by three points, namely by a point 30 which is formed by the point of the ~~eross-section~~ cross-section of the longitudinal rib 3 that is furthest from the outer surface 5 in a triangular or round cross-sectional area. In a ~~eross-sectional~~ cross-sectional area of the longitudinal rib 3 that is rectangular or trapezoidal in ~~eross-section~~ cross-section, the point 30 lies in the middle of the surface of the longitudinal rib 3 or ~~eross-section~~ cross-section facing away from the outer surface 5. The two further points by which the ~~eross-section~~ cross-section is defined are the two base points 31 of the longitudinal rib 3 or ~~eross-section~~ cross-section

**[0059] {0062}**—A triangle is formed with three points 30, 31, 31. The straight line 31-31 is now shifted parallel through the point 30, so that the point 30 is in the middle or halfway on this straight line 31-31. This results in a straight line with the two end points 31'-31'. A straight line is now placed through the points 31 and 31'. The direction of these straight lines 31-31' provides the direction of projection. That is, in principle, a parallelogram defines the triangle 30-31-31, the one side of which is formed by the base straight line 31-31.

**[0060] {0063}**—At least one longitudinal rib 3 should have a radial projection direction for structural and procedural reasons. On the whole, the annular element in Fig. 1a has nine longitudinal ribs 3 in three groups with three different directions of projection. A longitudinal rib 3 each of every group has a radial direction of projection.

**[0061] {0064}**—Moreover, it is advantageous if the longitudinal ribs 3 are arranged at regular distances from one another. This results in an increased stability and improved anchoring.

**[0062] {0065}**—As can be seen in Fig. 1b, transverse ribs 2, extending parallel to one another in peripheral direction can be provided on the outer surface 5, ~~[[said]]~~ the transverse ribs optionally crossing the longitudinal ribs 3. This results in structural advantages and increases the stability, in particular when the transverse ribs 2 extend peripherally in a continuous manner.

**[0063] {0066}**—The annular element 1 is divided into three similar annular segments 10 in Fig. 1a. In Figs. 1d and 2a, an annular segment 10 of this type is shown separately.

Basically, an annular element 1 can be composed of a variable number of annular segments 10. In Figs. 3a to 3d, current possibilities are noted. Thus, the annular element 1 may consist of two, three, four, six, eight or ten annular segments 10. A central aperture angle or a central angle  $\alpha$  is defined for each annular segment 10 in the median axis 7. The smaller the annular element 10, the smaller the form can be and the easier the annular segment is to transport.

**[0064] [0067]**—It is also advantageous if the annular segments 10 together with the longitudinal ribs 3 are built identical to one another. That is, an annular element 1 may be composed of several identical annular segments 10.

**[0065] [0068]**—The annular segment 10 shown in Figs. 1d and 2a has three longitudinal ribs 3 which have projection directions from the outer surface 5 that are parallel to one another. The middle rib of these longitudinal ribs 3 lies on the angular symmetrical plane 20 of the central angle  $\alpha$  and, as a result, also has a radial direction of projection. The two other longitudinal ribs 3 are arranged equidistantly or symmetrically to the angular symmetrical plane 20.

**[0066] [0069]**—In Fig. 2c, the longitudinal rib 3 on the angular symmetrical plane 20 can be seen in a large-scale view.

**[0067] [0070]**—For the production of the annular segments 10, it is advantageous if the projection directions of the longitudinal ribs extend parallel to one another since only then is it possible to easily release or extract it from the mold.

**[0068] [0071]**—If all longitudinal ribs 3 project in a radial direction from the outer surface 5, this would result in an undercutting during extraction or release from the mold and the annular segment 10 could no longer be removed from the mold without damage to the longitudinal ribs 3 or a deformation of the form or the annular segment 10.

**[0069] [0072]**—To be able to assemble the annular segments 10 to form the annular element 1, broad surfaces 16 of the flange that extend radially outward and/or inward can be formed on the straight broad sides 15 of each annular segment 10. Broad surfaces 16 of the flange are shown in a detailed view in Figs. 2b or 2d, whereby Fig. 2d shows two adjacent flange broad surfaces 16 of two adjacent annular segments 10.

**[0070] [0073]**—To be able to assemble the annular elements 1 to form a pipe-cased shaft, channel shaft, manhole, maintenance shaft or the like, it is advantageous if outwardly and or



inwardly extending longitudinal flange surfaces 18 are formed on the curved longitudinal sides normal to the median axis or axis of curvature 7.

**[0071] [0074]**—Recesses 21 for fastening means can be provided in the broad surfaces 16 and/or longitudinal surfaces 18 of the flange. The annular segments 10 or the annular elements 1 can also be screwed or glued or welded together. Advantageously, this connection should be watertight.

**[0072] [0075]**—Transverse ribs 2 formed on the annular segments 10 which extend on the outer surface 5 in peripheral direction and parallel to one another can be seen in Figs. 2e and 2f.

**[0073] [0076]**—Detail views of these transverse ribs 2 or the longitudinal surfaces 18 of the flange are shown in Figs. 2g to 2j. Two transverse ribs 2 can also be formed directly or tightly adjacent to one another, as a result of which smaller annular elements 1 or annular segments 10 of low height can be obtained by cutting between these transverse ribs 2.

**[0074] [0077]**—An annular element 1 in the form of a truncated conical casing is shown in Figs. 4a, 4b, 5a and 5b, whereby the truncated cone in Figs. 4a and 4b is a straight truncated cone and a sloping truncated cone in Figs. 5a, 5b. In this embodiment, the annular element 1 consists of two assembled annular segments 10. Smaller subdivided units during production of the annular segments 10 are advantageous for transportation, however, they require several operational steps when being assembled on site or in the factory.

**[0075] [0078]**—The shape of the longitudinal ribs 3 along the generatrix of the truncated conical casing can be clearly seen in these drawings.

**[0076] [0079]**—An embodiment of a truncated conical annular element is shown in Figs. 6a and 6b which also has transverse ribs 2 in addition to the longitudinal ribs 3.

**[0077] [0080]**—Preferably, the annular segments 10 or annular elements 1 are made of waste-water resistant, in particular acid-proof, plastic, in particular of polyethylene, preferably HDPE, of polypropylene or glass fibre-reinforced fiber-reinforced plastic. The material should protect the concrete against aggressive contents in the waste water, e.g. sulfuric acid, hydrogen sulfide, etc.

**[0078] [0081]**—The annular elements 1 or the annular segments 10 are produced according to current methods, in particular casting, injection molding, pressure die casting or briquetting methods.

**[0079] [0082]**—The thickness of the annular elements 1 or the annular segments 10 is usually between 3 and 8 mm. Annular elements 1 or annular segments 10 of this type are, for the most part, not placed in the ground without a concrete jacket, whether it be industrially or at the building site. Advantageously, the entire shaft is surrounded by concrete, however, several annular elements 1 can also be poured to form a shaft part, whereby several shaft parts are assembled to form the entire shaft. The concrete jacket also serves as relief against the outside pressure of the ground. The longitudinal ribs 3 and, optionally, the transverse ribs 2 provide a better adhesion between concrete and the annular elements 1 or annular segments 10 and prevent the annular elements 1 or annular segments 10 from separating from the surrounding concrete jacket.

**[0080] [0083]**—However, annular elements 1 or annular segments 10 of appropriate thickness, e.g. 20 to 30 mm which are, in particular, tightly connected to one another, preferably welded together, are also quite feasible. Shafts built in this manner can be used without a concrete jacket or concrete grouting and surrounded by earth. The longitudinal ribs 3 and, optionally, the transverse ribs 2 serve to anchor and prevent the annular elements 1 or the entire shaft from shifting.

**[0081] [0084]**—Fig. 9 shows detail A of Fig. 2b corresponding to a sectional view through abutting broad surfaces 16 of the flange. A recess 16' is formed in at least one of these broad flange surfaces 16 which serves to accommodate a seal with which the two abutting broad flange surfaces 16 can be sealed. The groove 16' and the seal (not shown) extend along the broad surface of the flange 16.

**[0082] [0085]**—Fig. 10 shows a view of the detail G according to Fig. 2j. In two opposite longitudinal flange surfaces 18 18', a groove 18' for accommodating a seal (not shown) with which these two longitudinal flange surfaces 18 can be sealed is formed in at least one of these longitudinal flange surfaces.

**[0083] [0086]**—The embodiments of the sealing arrangements according to Figs. 9 and 10 thus offer the possibility of assembling the annular elements in a sealing manner and producing a tight shaft due to the seals 16" or 18" inserted in the broad surfaces 16 of the flange and in the longitudinal surfaces 18 of the flange.

